

EZECAL MK4 USER MANUAL



EZECAL MK4 USER MANUAL**Contents**

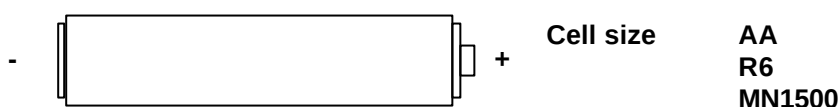
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1 General.

Thank you for purchasing this superb piece of British engineering. If you look after it carefully it will reward you with many years of faithful service.

1.1 Battery installation/replacement and recharging.

The EZECAL is supplied with 4 off "AA" size nickel cadmium batteries. These batteries may be recharged as required using the optional EZECAL recharging unit. If necessary the batteries may be replaced with alkaline or zinc/carbon batteries, however these must be thrown away when they run out and, under no circumstances should any attempt be made to recharge them.



To install new batteries, first ensure the EZECAL is switched off and remove the lid of the battery compartment by lightly pressing the region marked "OPEN" and sliding the lid towards the terminals. Remove the old batteries and dispose of them carefully. Fit the new batteries observing the polarity markings printed inside the compartment and on the battery and refit the lid. The EZECAL is now ready for use.

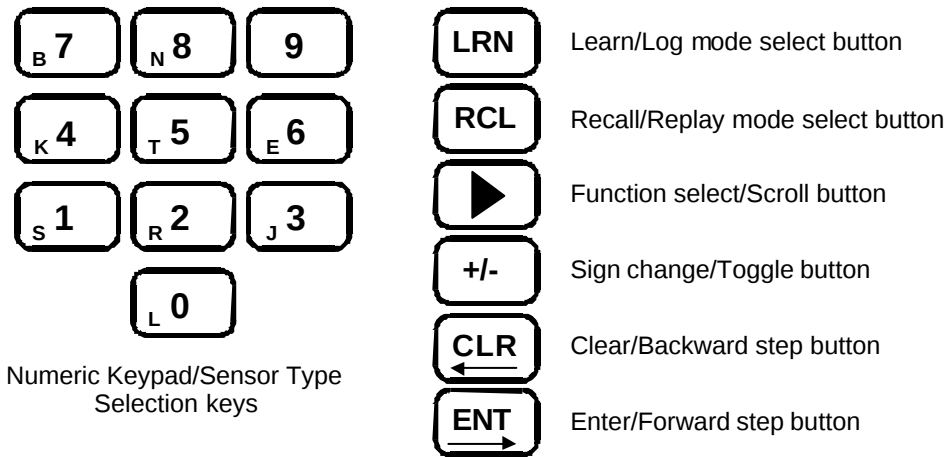
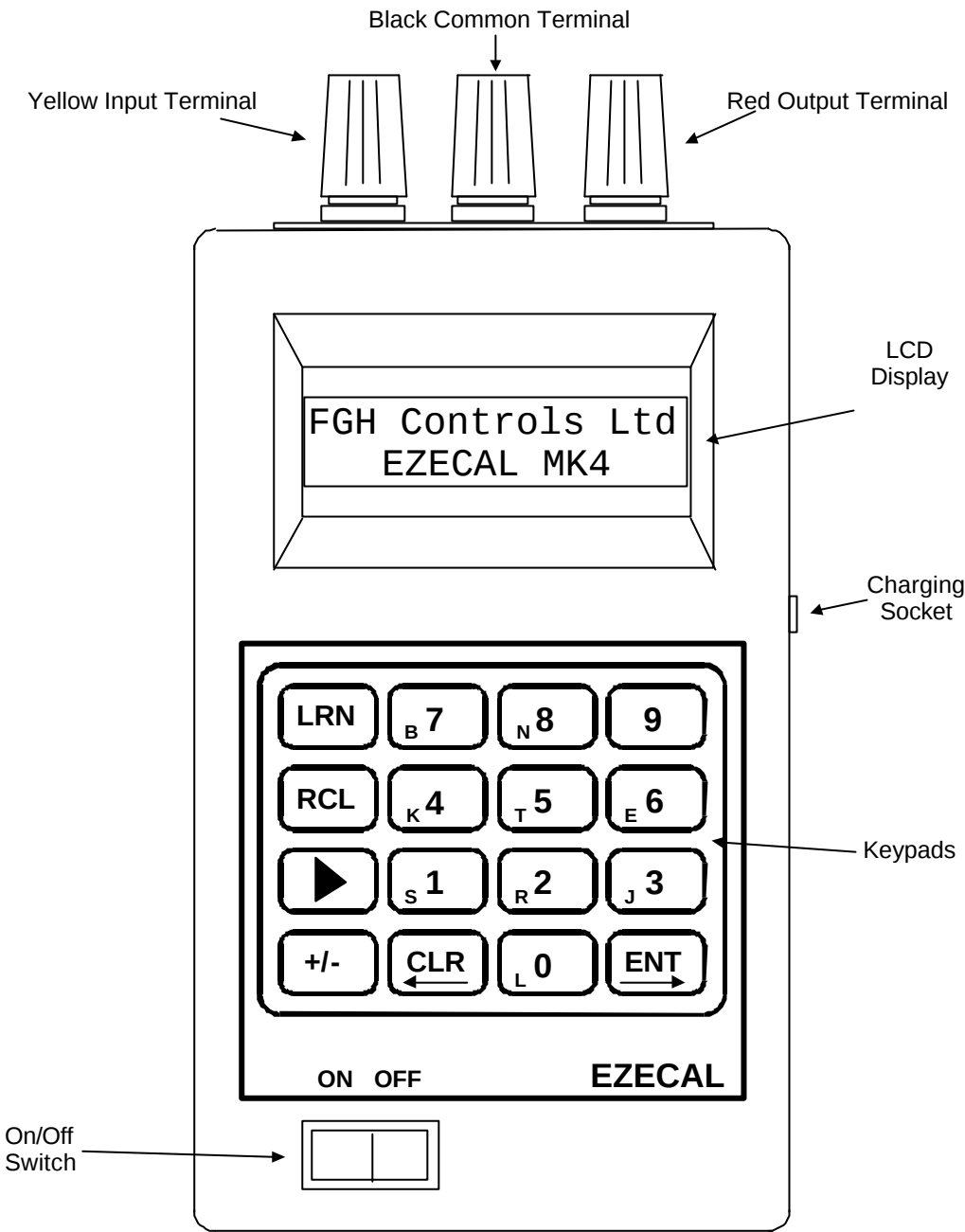
Recharging Nickel Cadmium batteries.

The EZECAL may be recharged either from the optional mains adapter or car cigar lighter adapter. To recharge, first switch off the EZECAL and then plug the charging lead into the side of the unit. Leave the unit for 16 hours to fully charge the batteries. The EZECAL will provide approximately 20 hours of continuous use with freshly charged batteries.

If necessary the EZECAL may be used whilst charging is in progress, in this case recharging will take slightly longer to complete.

WARNING. DO NOT USE THE CHARGER UNIT TO POWER THE EZECAL EXCEPT WHEN RECHARGEABLE BATTERIES ARE FITTED.

1.2 Nomenclature.



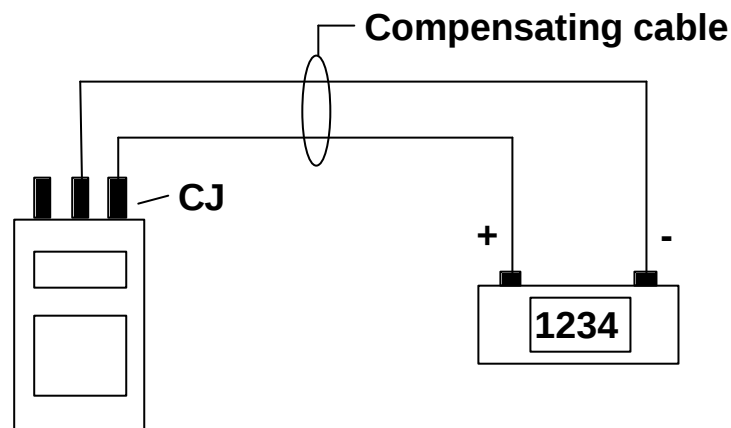
1.3 Connecting the EZECAL in simulation mode.

The EZECAL unit is intended for the calibration and checking of temperature measurement or control instruments using any of the BS 4937 standard thermocouples. The simulator eliminates the need for thermocouple emf look up tables, tedious cold junction calculations and temperature unit conversions. It also provides a rapid means of checking the actual thermocouple.

For thermocouple simulation purposes the EZECAL unit can be connected to the instrument under test in three different ways.

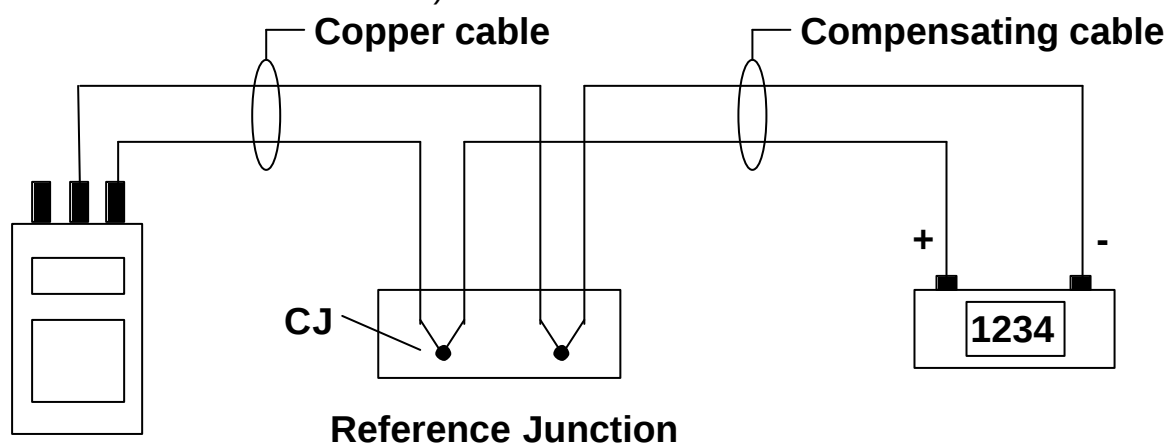
AUTOMATIC COLD JUNCTION METHOD.

The EZECAL is wired to the instrument under test in the appropriate compensation cable. The EZECAL should be set to its AUTO cold junction mode (see section 2.3). In this mode the EZECAL will automatically measure the temperature of its own terminals and adjust the output emf to compensate.



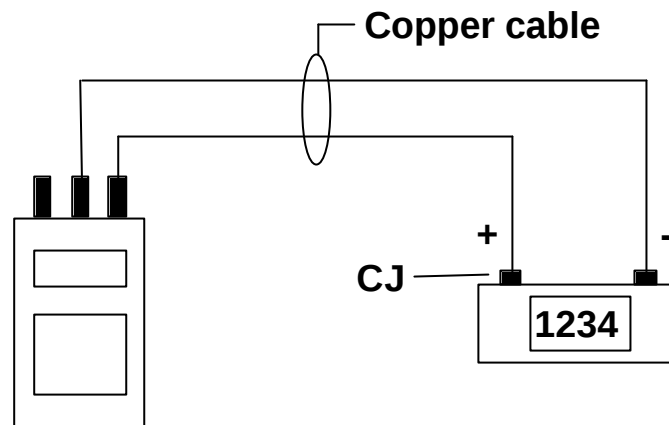
MANUAL COLD JUNCTION METHOD 1

The EZECAL is wired in copper cable to a reference junction and hence in the appropriate compensating cable to the instrument under test. For this method of connection the EZECAL should be set to its MANUAL compensation mode and the temperature of the reference junction entered. (see sections 2.3 and 2.4). The reference junction point can be any stable or temperature controlled environment between -10 and +55 °C. (melting ice is commonly used as a reference environment of 0 °C).



MANUAL COLD JUNCTION METHOD 2

The EZECAL is wired in copper cable to the instrument under test. For this method the simulator should be put into its MANUAL compensation mode and the temperature at the terminals of the instrument under test entered. (see sections 2.3 and 2.4) This method of connection is the least reliable of the three described and should only be used for rough checking, as changes in ambient temperature will affect the readings on the instrument under test.

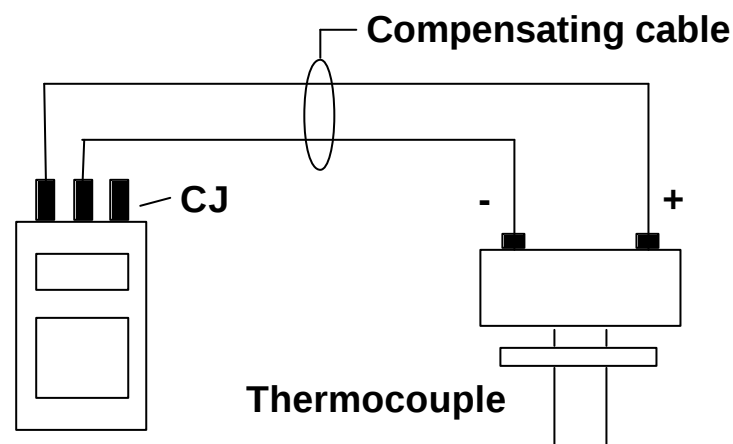


1.4 Connecting the EZECAL in measure mode.

In order to use the Ezecal to measure temperature via a thermocouple the EZECAL should be connected in one of the three following ways.

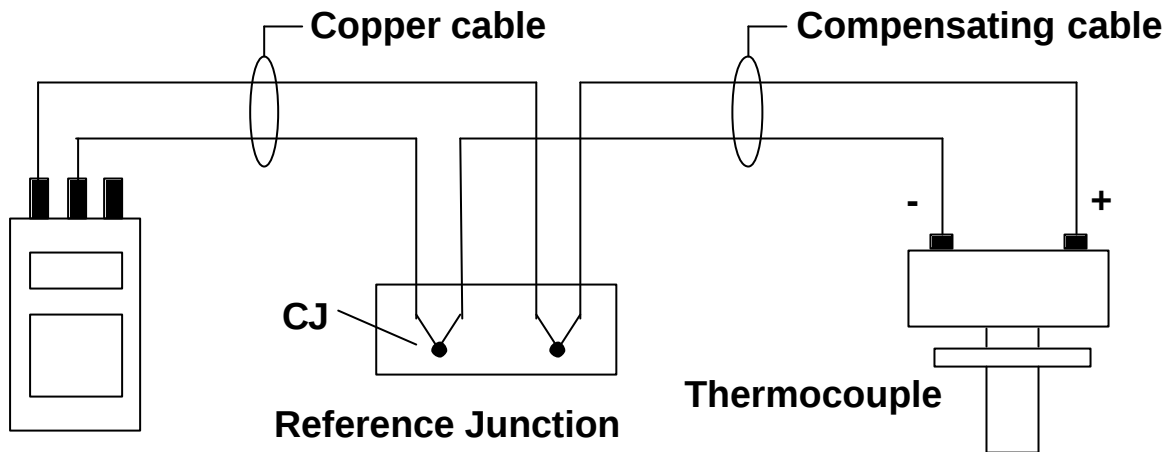
AUTOMATIC COLD JUNCTION METHOD.

The EZECAL is wired to the instrument under test in the appropriate compensation cable. The EZECAL should be set to its AUTO cold junction mode (see section 2.3). In this mode the EZECAL will automatically measure the temperature of its own terminals and adjust the output emf to compensate.



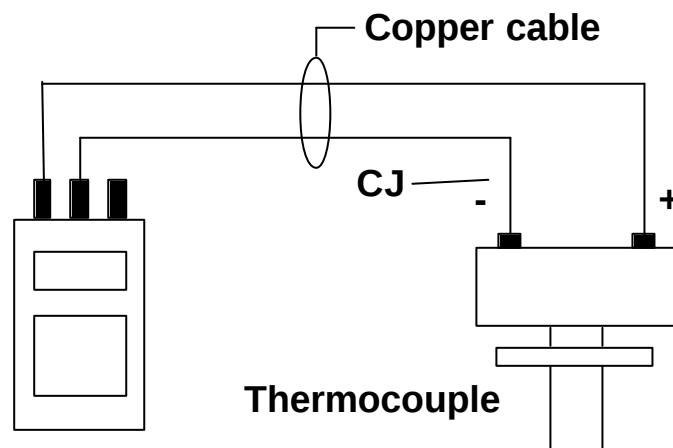
MANUAL COLD JUNCTION METHOD 1

The EZECAL is wired in copper cable to a reference junction and hence in the appropriate compensating cable to the instrument under test. For this method of connection the EZECAL should be set to its MANUAL compensation mode and the temperature of the reference junction entered. (see sections 2.3 and 2.4). The reference junction point can be any stable or temperature controlled environment between -10 and +55 °C



MANUAL COLD JUNCTION METHOD 2

The EZECAL is wired in copper cable to the instrument under test. For this method the simulator should be put into its MANUAL compensation mode and the temperature at the terminals of the instrument under test entered. (see sections 2.3 and 2.4) This method of connection is the least reliable of the three described and should only be used for very rough temperature measurements.



NOTE: For measurements with type B thermocouples or linear transducers the EZECAL should be connected as shown above. The set mode of compensation does not matter in this case.

1.5 Using the keyboard.

The numeric keypad on the EZECAL is used just like a calculator. To enter a number simply press the numeric keys in the usual order. On the first key press the existing number will be cleared and a flashing cursor and question mark will appear. The cursor indicates where the next number pressed will be displayed. Digits already entered will be shifted one space to the left. The ENT key must be used at all times to enter the number, at which point the cursor and question mark will disappear. Negative numbers are entered by using the +/- key to negate the number entered at any time.

Mistakes can be corrected by pressing the CLR key at any time during input and re-entering the correct number. Alternatively the incorrect number may be overwritten by the correct one after pressing the ENT key.

Examples.

Entering a positive number

existing display +100.0°C

	+	.1?
	+	1.2?
	+	12.3?
	+	12.3°C

Entering a negative number

existing display +100.0°C

	+	.1?
	+	1.0?
	+	10.0?
	-	10.0?
	-	10.0°C

Correcting a mistake

existing display +1000°C

	+	.1?
	+	1.2?
	+	.?
	+	.1?
	+	1.3?
	+	1.3°C

Entering a number out of limits

existing display +.0°C

	+	.1?
	+	1.7?
		Error
	+	.1?
	+	1.6?
	+	1.6°C

2 Setting up the EZECAL.

This section describes how to set up the EZECAL to simulate or measure the particular thermocouple of interest, the temperature units and the cold junction compensation mode.

2.1 Setting the thermocouple type.

The EZECAL can simulate or measure any of the eight standard thermocouple types specified under BS 4937, these are :-

Pt10%Rh/Pt	type S	-50.0 to 1767.0	deg's C
Pt13%Rh/Pt	type R	-50.0 to 1767.0	deg's C
Fe/Cu	type J	-210.0 to 1200.0	deg's C
NiCr/NiAl	type K	-270.0 to 1372.0	deg's C
Cu/CuNi	type T	-270.0 to 400.0	deg's C
NiCr/CuNi	type E	-270.0 to 1000.0	deg's C
Pt30%Rh/Pt6%Rh	type B	-0.0 to 1820	deg's C
NiCrSi/NiSi	type N	-270.0 to 1300	deg's C
also Linear millivolts		-99.99 to +99.99	mV
		and equivalents in deg's F.	

One custom thermocouple range may also be included to special order.

W5%Re/W26%Re	type W5	-0.0 to 2320.0	deg's C
Fe/CuNi	type L (DIN 43710)	-200.0 to 900	deg's C
		and equivalents in deg's F.	

The sensor type is set by using the scroll key until the thermocouple type is displayed and then pressing a numeric key to set the required type. Custom ranges are always invoked using key 9.

For example.

OUTPUT +1760.0°C
Type:S CJC:Man

▶▶

4

K

9

K

0

L

Thermocouple S
Select using 0-9

Thermocouple K
Select using 0-9

Thermocouple W5
Select using 0-9

Thermocouple Lin
Select using 0-9

Display shows
current type

to set type K

to set type W5
(custom range)

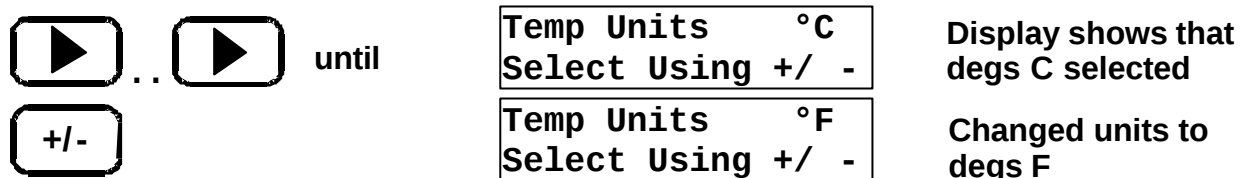
to set linear

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2.2 Selecting the temperature units.

The EZECAL can work in either degs C or degs F. To change the temperature units press the SCROLL key until the temp units message is displayed, and then use the +/- key to toggle between degs C and degs F.

For example.

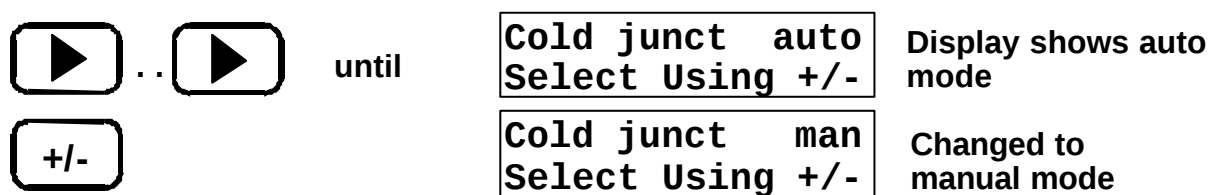


2.3 Selecting Cold junction Compensation mode.

The EZECAL is capable of measuring the temperature of its terminals and adjusting the simulated output or measured input accordingly. This automatic adjustment can be switched on or off as required depending on the way the unit is connected (see section 1.4). If compensation cable is used to connect the EZECAL to the thermocouple or instrument then the automatic mode should be used. If, however an external reference junction is used then the manual mode should be selected and the reference temperature should be entered.

To switch between automatic or manual compensation, press the SCROLL key until the compensation message is displayed. Then use the +/- key to toggle between AUTO and MANUAL.

For example



2.4 Cold junction compensation temperature.

For operation in manual cold junction mode, it is up to the user to enter in the actual cold junction temperature. The location of the cold junction depends on how the EZECAL is wired (see sections 1.3 and 1.4). The valid range for this temperature is -10 to +55 degs C or 14 to 131 degs F. The lower line of the display indicates the valid range. In Automatic compensation mode there is no need to enter this temperature, the EZECAL will measure the temperature automatically and its value will be shown on the display. If this measured temperature is outside the specified limits of -10 to +40 degs C (or equivalent) and error message will be displayed.

For example in MANUAL CJC mode.

▶

▶

..

until

2

R

8

N

5

T

ENT

→

CJ Temp + 24.0°C

From -10 to 55°C

CJ Temp + .2?

From -10 to 55°C

CJ Temp + 2.8?

From -10 to 55°C

CJ Temp + 28.5?

From -10 to 55°C

CJ Temp + 28.5°C

From -10 to 55°C

Existing CJ temp

is displayed

A new cold junction temperature of 28.5 degs C has now been entered.

In AUTOMATIC CJC mode.
Display shows internally measured CJ temperature.

CJ Temp + 24.2°C

Display indicates measured CJ temperature is out of range.

CJ Temp + Error
CJ RANGE ERROR

3.0 Simulation Mode.

Simulation mode is used to simulate the set thermocouple type. The required temperature is entered on the keypad and the equivalent emf with compensation if required will be output to the simulate terminals directly after the ENT key is pressed.
First of all the EZECAL must be set to SIMULATE mode.

▶

▶

..

until

+/-

Mode Measure

Select Using +/-

Mode Simulate

Select Using +/-

Existing mode is

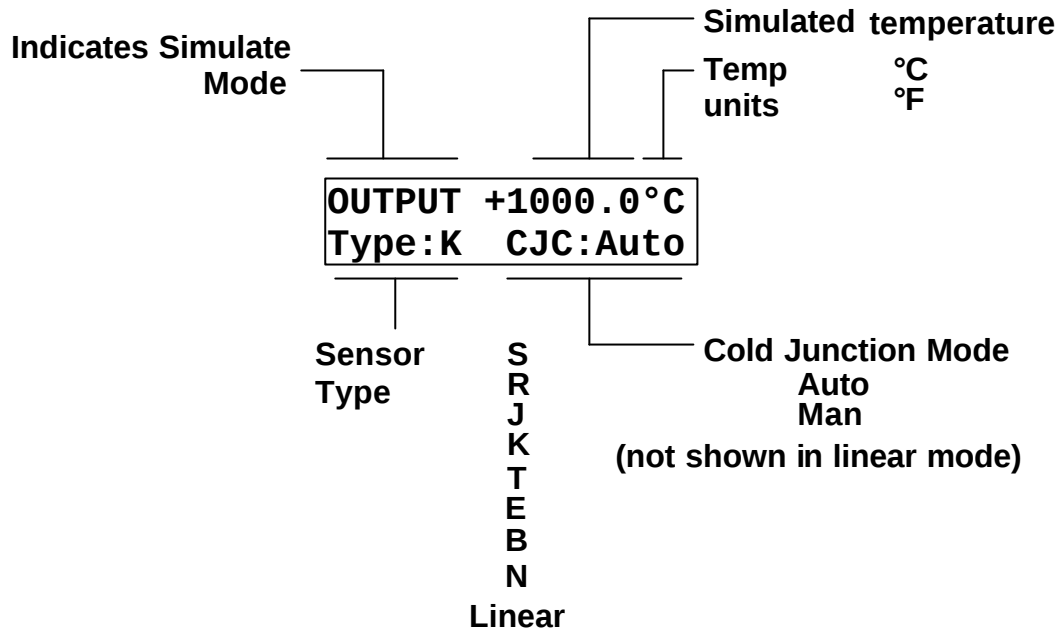
displayed

Mode changed to

Simulate

3.1.1 Simulation mode display indications.

Simulation mode is recognised by the word "OUTPUT" appearing on the top line of the display. The current set-up and actual temperature being simulated is also displayed along



with any error conditions that may arise.

3.1.2 Manual temperature simulation.

In simulation mode the required temperature is simply entered on the keypad and, if valid, will appear at the output terminals upon depression of the ENT key. If the entered temperature is outside the valid range for the sensor selected then an error screen will appear:-

```

OUTPUT      Error
* OUT OF RANGE *
  
```

This error is quickly cleared by simply pressing CLR or re-entering a valid temperature:-

```

OUTPUT      Error
* OUT OF RANGE *

[CLR]

OUTPUT      ?
* OUT OF RANGE *
  
```

To enter a temperature for simulation. For example 1000.0 °C:-

```

[1] [0] [0] [0] [0] [ENT] OUTPUT +1000.0 °C
  Type:K   CJC:Auto
  
```

Negative temperatures are also easily entered:-

```

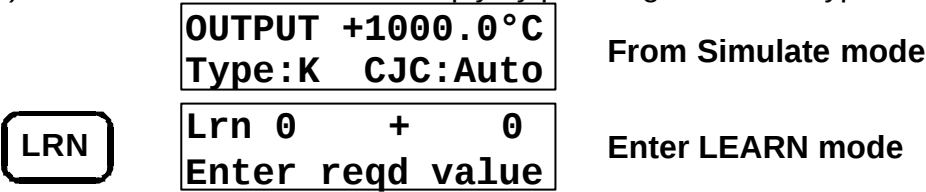
[+/-] [2] [0] [0] [0] [ENT] OUTPUT -200.0 °C
  Type:K   CJC:Auto
  
```

3.2 Learn Mode.

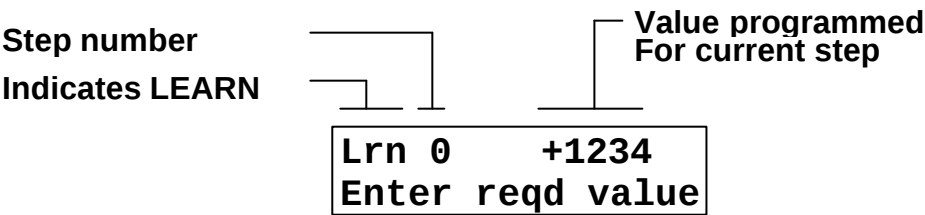
The LEARN mode is used to program the simulator to produce a series of temperatures. This is useful if, for instance the user wishes to check the calibration of several instruments at various positions in their range. In this case the user could use learn mode to teach the simulator the required list of temperatures. Then using the RECALL mode each instrument could be checked very quickly and easily by recalling each test temperature with a single keystroke. Alternatively the time base facility could be used to automatically step through the sequence of temperatures without user intervention.

3.2.1 Programming a series of temperatures.

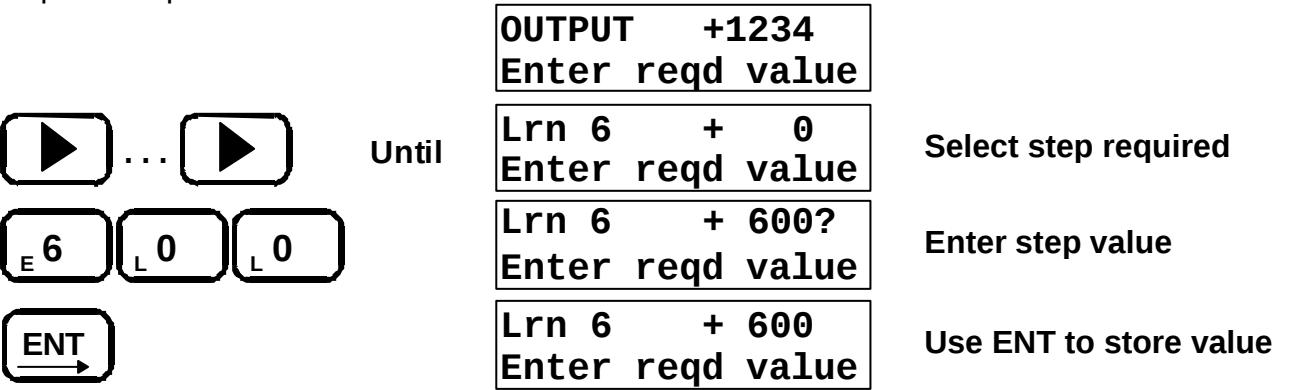
In order to teach the simulator a series of temperatures, The EZECAL must be in SIMULATE MODE (see section 3.0). LEARN mode is activated simply by pressing the LRN keypad.



The LEARN mode display.



Learn mode can store up to 10 step values. Each step is assigned a number 0 to 9 and this is shown on the display at all times.
To teach the EZECAL a new step value the SCROLL key should be used to select the required step number:-



To exit from learn mode:-

LRN

Lrn 6 + 600
Enter reqd value

OUTPUT +1000.0°C
Type:K CJC:Auto

In LEARN mode

Press LRN again to exit

3.3 Recall mode.

Recall mode is used to recall one or more preset temperatures previously stored in the learn mode. These temperatures may be recalled manually or in sequence using the time base facility. The EZECAL can also be set to ramp between the preset temperatures if required. To enter RECALL mode:-

RCL

Timebase Off
Enable using +/-

First activate the time base if required

+/-

Timebase 0.2m
Enter value reqd

Timebase activated

E6 L0 L0 ENT

Timebase 60.0m
Enter value reqd

Enter timebase value up to 999.9 mins

▶

Rcl mode Step
Select Using +/-

Now set recall mode Step or Ramp

+/-

Rcl mode Ramp
Select Using +/-

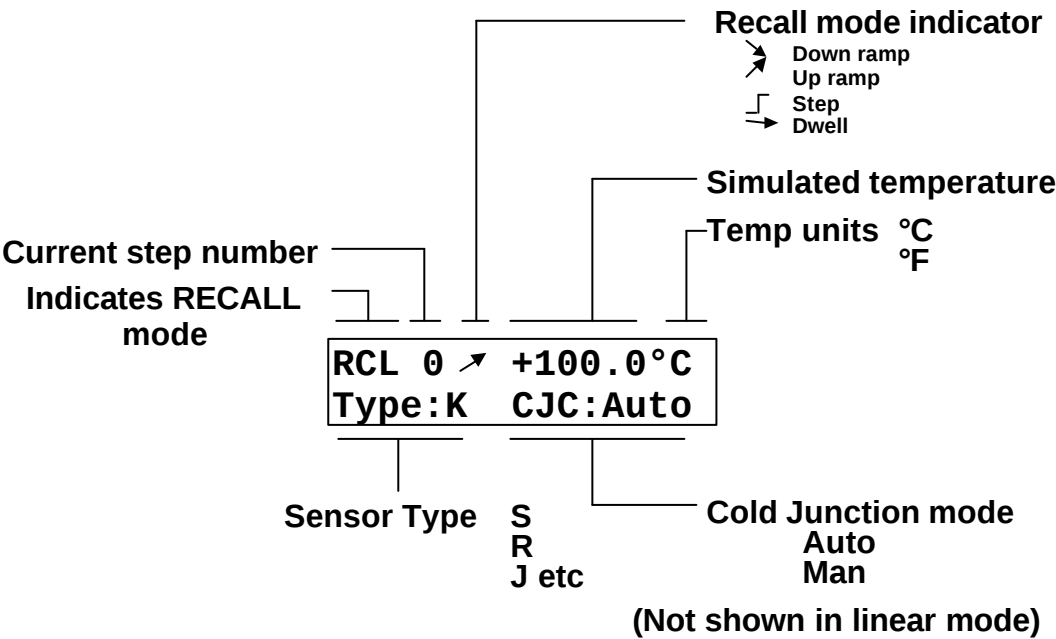
Change to ramp mode if Required using +/- key

▶

Rcl 0 t +100°C
Type: K CJC:Auto

Press scroll to enter recall mode

Recall mode display indications.



In recall mode it is not possible to manually enter temperatures.

3.3.1 Recalling a series of temperatures.

When first entering recall mode initially the recalled step number will be zero, however any of the 10 available steps can be recalled simply by pressing the relevant numeric key.

	Rcl 0 + 100.0°C Type:K CJC:Auto	Initially step 0 is invoked
	Rcl 6 + 600.0°C Type:K CJC:Auto	Step 6 called up directly
	Rcl 9 + 900.0°C Type:K CJC:Auto	or step 9

If the programmed values were intended to be used as a sequence, then the user may manually step through this sequence by use of the ENT key (forwards) and the CLR key (backwards).

	Rcl 0 + 100.0°C Type:K CJC:Auto	
	Rcl 1 + 200.0°C Type:K CJC:Auto	Steps forwards
	Rcl 0 + 100.0°C Type:K CJC:Auto	or backwards

If the time base facility was enabled and a non zero time was entered then the EZECAL will automatically step through the sequence, one step every time base period. When the step number reaches 9 or a step value is found to be zero the step number will wrap around to step zero again. The steps may still be recalled manually as in the above two examples. In this case the time base will be restarted after every manual step.

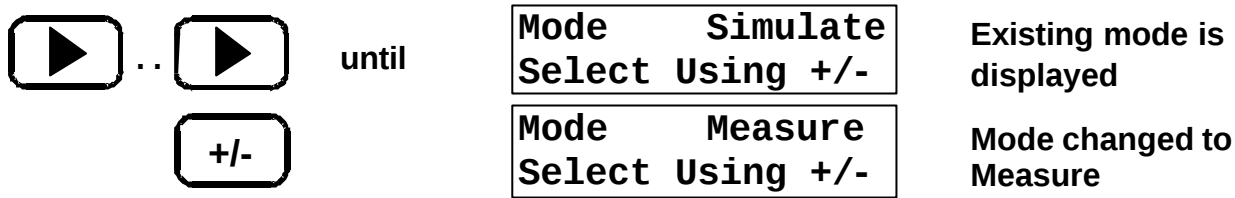
If a long time base period is used it may be useful to know how much time is left until the next step. This can be displayed if the +/- key is pressed and will appear on the bottom display line as long as the key is held down.

	Rcl 0 ▯ +100.0°C Type:K CJC:Auto	
	Rcl 1 ▯ +200.0°C Next step 2.0m	Time to next step shown

4.0 Measure Mode.

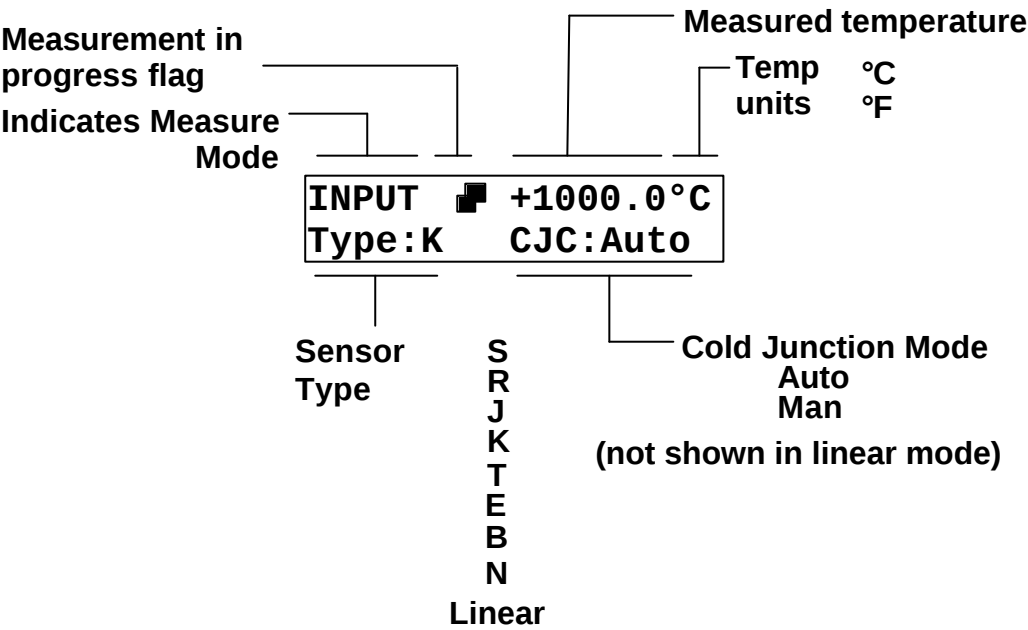
Measure mode is used to measure the emf signals from the set type of thermocouple. The actual temperature is shown on the correctly compensated dependant upon the compensation mode set (see section 2.3).

To set the EZECAL to MEASURE MODE:-

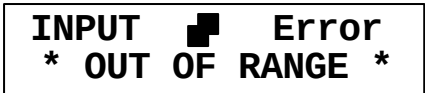


4.1 Measure mode display indications.

Measure mode is recognised by the word "INPUT" appearing on the top line of the display. The current sensor type cold junction compensation mode is also displayed along with any



error conditions that may arise.
If the measured temperature is outside the valid range for the type of sensor selected the display will indicate a range error.



If the cold junction temperature is outside the allowed limits the display will indicate a cold junction error.



4.2 Log Mode.

Log mode may be used by the user to log or monitor a thermocouple over a period of time. The EZECAL will store up to 50 temperatures whilst logging. If the unit is left for a long time such that more than 50 readings are taken, then the last 50 will be remembered. The logged values may be replayed at a later stage (speeded up or slowed down) into a chart recorder or any desired instrument. Whilst logging the EZECAL will keep a separate note of the maximum and minimum temperatures encountered along with the average temperature and the period of any oscillation encountered.

Log mode may only be invoked from measure mode by pressing the LRN key:-

INPUT +1000.0°C
Type:K CJC:Auto

LRN

Timebase Off
Enable using +/-

4.2.1 Setting the log timebase.

As log mode is invoked the log timebase is displayed. This is the desired time interval between each log. For log mode, the time base must be enabled and have a value set between 0.1 and 999.9 minutes.

Timebase Off
Enable using +/-

+/-

Timebase 0.2m
Enter value reqd

Timebase 60.0m
Enter value reqd

E 6 L 0 L 0 ENT

Timebase activated

Enter timebase value up to 999.9 mins

4.2.2 Starting and stopping the log.

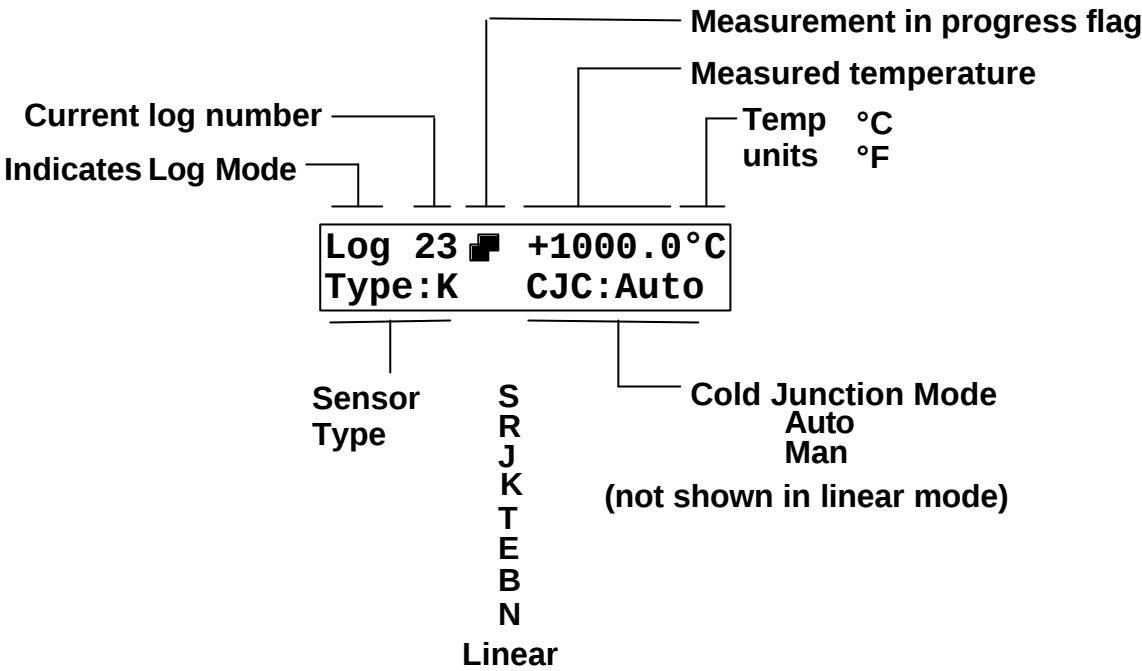
The log is started simply by pressing the scroll key, and will continue logging until manually stopped.

Timebase 60.0m
Enter value reqd

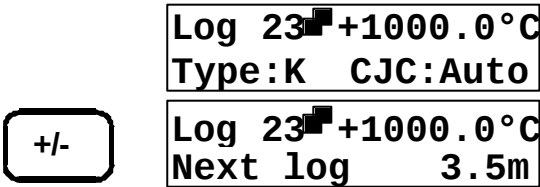
Log 01 +100.0°C
Type:K CJC:Auto

Press scroll to start logging

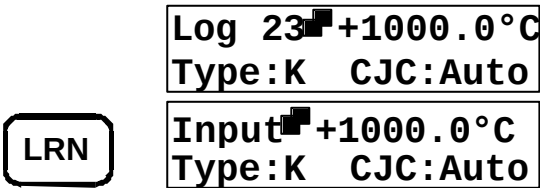
The following screen will be displayed throughout the log:-



At any time during the log the time remaining to the next log may be displayed by pressing the +/- key.
This display will remain for as long as the +/- key is held down.



To stop the log and exit log modes simply press the LRN key:-

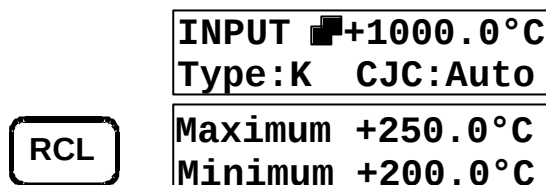


The log values stored may now be examined or replayed in REPLAY mode (see following section).

4.3 Replay Mode.

Replay mode is used to examine and replay the logged values obtained in log mode. Associated data such as maximum and minimum, average and period can also be examined in this mode.

To invoke REPLAY mode:-



4.3.1 Maximum and minimum logged values.

Whilst logging was in progress the EZECAL kept a record of the maximum and minimum of the logged values. These values are shown as the first display in replay mode.

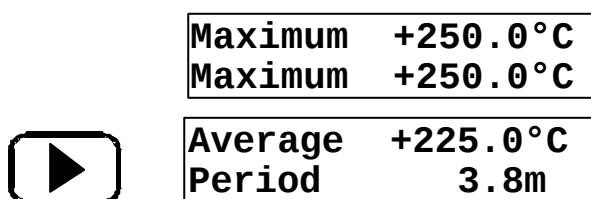
Maximum	+250.0°C
Minimum	+200.0°C

If there were no logged values and hence no maximum or minimum then an error message will be displayed.

Maximum	None
Minimum	None

4.3.2 Average and oscillation period of logged values.

The average and period values are displayed immediately after the maximum and minimum values by pressing the SCROLL key.



The displayed average is the average of all of the logged values taken.

The oscillation period is the time between the last 2 successive peaks during the logging period, provided at least 2 peaks were detected. If no peaks were detected during the log then the period value is displayed as "none".

Average	+120.5°C
Period	None

4.3.3 Setting the replay time base.

The logged values may be replayed at any speed regardless of the timebase used at the time they were recorded. This enables the values to be replayed rapidly into a chart recorder for instance. The replay timebase can be either “off” (manual replay) or a value between 0.1 and 999.9 minutes, and is set exactly as the log and recall timebases.

Average +120.5°C
Period 3.8m

Timebase Off
Enable using +/-

Timebase 0.2m
Enter value reqd

Timebase 60.0m
Enter value reqd

First activate the time
base if required

Timebase activated

Enter timebase value
up to 999.9 mins

4.3.4 Replaying the logged values.

The values recorded during the log may be replayed in sequence using the time base, or may be manually replayed by means of the keypad. In either case the values must be replayed in the same sensor type and temperature units in which they were logged. The EZECAL will force the sensor type and units automatically. As each value is replayed, the EZECAL will simulate the replayed temperature and this emf will appear (with relevant compensation) on the output terminals. To start the replay:-

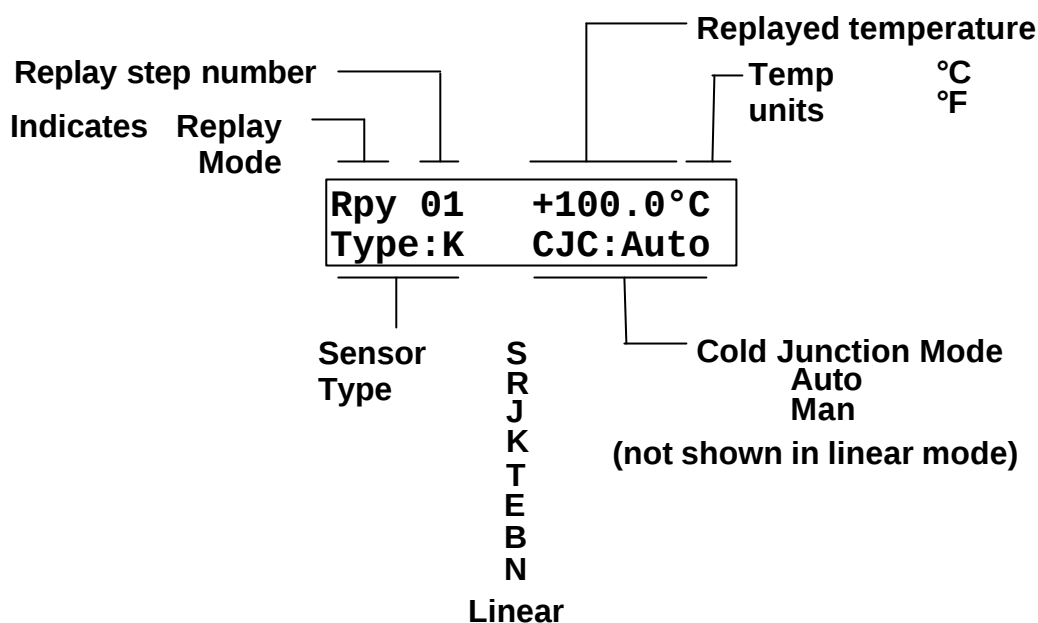
Timebase 60.0m
Enter value reqd

Rpy 01 +100.0°C
Type:K CJC:Auto-

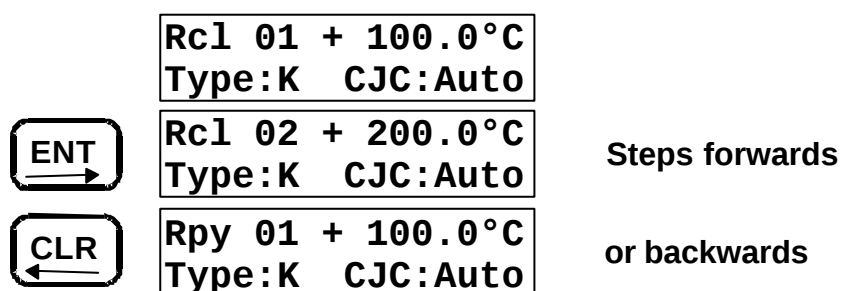
Press scroll to enter
Replay mode

Display indications during REPLAY mode.

Recall mode display indications.

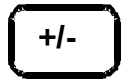


When first entering replay mode initially the replayed step number will be one, the user may manually step through the values by use of the ENT key (forwards) and the CLR key (backwards).



If the time base facility was enabled and a non zero time was entered then the EZECAL will automatically step through the logged values, one step every time base. When the step number reaches 50 or the number of logged values, the step number will wrap around to step one again. The steps may still be recalled manually as in the above example. In this case the time base will be restarted after every manual step

If a long time base period is used it may be useful to know how much time is left until the next step. This can be displayed if the +/- key is pressed and will appear on the bottom display line as long as the key is held down.

	Rpy 04 + 100.0°C Type:K CJC:Auto	Time to next step shown
	Rpy 24 + 100.0°C Next step 2.0m	

To terminate the replay at any time and return to measure mode simply press the RCL key again:-

	Rpy 24 + 100.0°C Type:K CJC:Auto
	INPUT  +123.4°C Type:K CJC:Auto

5. Specifications.

5.1 Physical.

Size uncased	: 200 x 100 x 45mm
Weight	: 450g
Power source	: 4 x AA NiCd rechargeable batteries
Battery life	: approx. 20 hours continuous use
Ambient temp	: -10 to +40 °C
Humidity	: 0 to 95%RH non condensing
Case material	: Black A.B.S

5.2 Electrical.

Simulation and Measuring.

Basic resolution	: 5uV 1 in 40000
Basic linear accuracy	: better than 0.05% of span (at ref. conditions 20 °C, 50% RH)

Setting resolution

Thermocouple ranges	: 0.1 deg C or 0.1 deg F
Linear range	: 10uV

Input noise rejection	: better than 70dB
Sampling frequency	: 20 samples per second
Display update time	: 0.8 seconds

Cold junction.

Accuracy	: +/- 0.25 °C
Resolution	: 0.1 °C or F
Range (auto mode)	: -10.0 to +40.0 °C
(manual mode)	: -10.0 to +55.0 °C
CJ rejection	: Better than 20:1

Ranges to BS4937

Type S	-50.0 to 1767.0 degs C
Type R	-50.0 to 1767.0 degs C
Type J	-210.0 to 1200.0 degs C
Type K	-270.0 to 1372.0 degs C
Type T	-270.0 to 400.0 degs C
Type E	-270.0 to 1000.0 degs C
Type B	-0.0 to 1820.0 degs C
Type N	-270.0 to 1300.0 degs C
and equivalents in degs F	

Linear	-99.99 to + 99.99 mV
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Output impedance	: Less than 0.1 Ohms
Max. output current	: +/- 1 milliamp
Warm up time	: Less than 1 minute
Output settle time	: 2 seconds to 99%

Battery low detection	: 4.5 Volts
Recharge time	: approx. 16 hours from low bat using approved charger
Power consumption	: 100mW max.

5.3 Conformity Table.

TYPE	RANGE	MAX ERROR(°C)
S	-50 to 0	1.17
	0 to 1767	0.73
R	-50 to -22	1.75
	-20 to +4	0.2
	5 to 50	0.12
	-51 to 1749	0.69
J	-210 to -140	0.18
	-139 to +2	0.08
	3 to 50	0.29
	51 to 1200	0.24
K	-270 to -250	2.0
	-249 to +99	0.24
	100 to 1373	0.32
T	-270 to -250	1.00
	-249 to -110	0.4
	-109 to +400	0.17
E	-270 to -250	1.5
	-249 to -160	0.27
	-159 to 0	0.1
	0 to 229	0.44
B	230 to 1000	0.16
	58 to 161	5.49
	162 to 250	1.81
	251 to 750	1.52
	751 to 1820	0.64
N	-270 to -235	3.01
	-234 to -170	0.63
	-169 to 0	0.25
	0 to 1300	0.38

The above table shows the worse case error (due to the internal lineariser) which may be expected on the given thermocouple over the specified temperature range. The absolute error on any given range is this error plus the error due the basic linear accuracy of +/- 0.05%.

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